

(19) World Intellectual Property Organization  
International Bureau(43) International Publication Date  
4 December 2003 (04.12.2003)

PCT

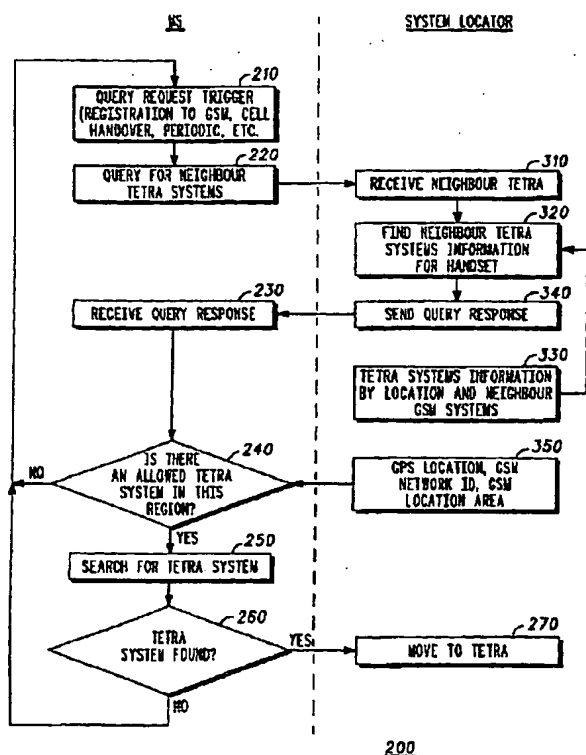
(10) International Publication Number  
**WO 03/101128 A1**(51) International Patent Classification<sup>7</sup>: **H04Q 7/20,**  
H04M 3/42(21) International Application Number: **PCT/EP03/50110**(22) International Filing Date: **16 April 2003 (16.04.2003)**(25) Filing Language: **English**(26) Publication Language: **English**(30) Priority Data:  
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[Continued on next page]

(54) Title: WIRELESS COMMUNICATION SYSTEM ARCHITECTURE, MOBILE STATION AND METHOD



(57) Abstract: A mobile station (172) is operable in at least a first wireless communication system (123) and in a second wireless communication system (173). The mobile station is operable to send to a System Locator (155) a query signal requesting the System Locator to provide information relating to connectivity of the mobile station with the first system, wherein the System Locator is accessible via the second system and the mobile station is operable to send said query signal during a period when it is connected by wireless to said second system. The first system may for example be a TETRA system and the second system may for example be a GSM system. A wireless communication architecture of communication systems in which the mobile station may be used and a System Locator for use in such architecture are also described.

WO 03/101128 A1



SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Published:**

— *with international search report*

**WIRELESS COMMUNICATION SYSTEM ARCHITECTURE, MOBILE  
STATION AND METHOD**

**5 Field of the Invention**

This invention relates to a wireless communication system architecture, mobile station for use therein and communication method. In particular, it relates  
10 to the transmittal of information relating to wireless system location and connectivity.

**Background of the Invention**

15 Wireless communications systems, for example cellular telephony or private mobile radio communications systems, typically provide for radio telecommunication links to be arranged between a plurality of base transceiver stations (BTSs) and a  
20 plurality of subscriber units, often termed mobile stations (MSs). The term 'mobile station' generally includes both hand-portable and vehicular mounted radio units for transmission and receipt of radio communications of speech, data, video etc  
25 information.

Wireless communications systems are distinguished over fixed communications systems, such as the public switched telephone networks (PSTN),  
30 principally in that mobile stations move between service providers (and/or different BTS) and in

doing so encounter varying radio propagation environments.

5 In a wireless communication system, each BTS has associated with it a particular geographical coverage area (or cell). The coverage area is known as a serving cell and is defined by a particular range from the BTS within which the BTS can maintain acceptable communications with operating MSs. Often  
10 these cells overlap and combine to produce an expanded network coverage area. Furthermore, cells are often grouped into location areas for the purposes of tracking a MS within the coverage area whilst minimising location-updating signalling.

15 In the field of wireless communications, one of the most common complaints from mobile phone or radio customers is the unavailability of service in certain areas owing to lack of good radio frequency  
20 (RF) coverage, or lack of system coverage in large geographical areas such as coverage of a state. This is a problem even with MSs that support widely used networks such as the Global System for Mobile communications (GSM). This problem is more  
25 prevalent with MSs that support networks that are currently not as widely deployed, for example networks operating specifically for certain organisations, such as TETRA or iDEN<sup>TM</sup> systems which are usually owned and operated for the benefit of  
30 the particular user organisations.

One mechanism that has been chosen by some network operators and MS manufacturers to address the coverage problem is to provide dual-mode MSs to support two modes of operation. For example, a  
5 basic mode may be for the MS to communicate in a TETRA mode of operation, where direct (radio to radio) mode of communication is supported in addition to cellular operation using the network infrastructure in the TETRA network. As a secondary  
10 mode of operation, when the user is in an area where there is no TETRA network coverage available, the MS may be re-configured to operate directly as a cellular phone on a GSM network.

15 When operating in a GSM mode, the user and the network operator may be interested in returning the user to another network such as a TETRA network or a an integrated digital enhanced network (iDEN <sup>TM</sup>) network, as soon as possible, e.g. in order to use  
20 the dedicated communication services available.

The Applicant and its subsidiaries produce and market MSs, such as some iDEN MS models that support both an iDEN communication format and a GSM  
25 communication format. However, the switching between iDEN and GSM networks is only effected by the user when (s)he recognises that such switching is possible, and manually switches the mode of operation. Alternatively, such switching may occur  
30 automatically and without user control, as a user

loses coverage on one network and re-registers automatically on the other network.

5 In particular, a significant disadvantage with a manual switching approach is that the user will be unaware of whether (s)he is within the coverage range of the alternative communication system. The user may switch modes manually and intermittently so that the terminal can search for an alternative  
10 network, if the user suspects there might be an alternative network in the area. This is a tedious operation for the user, with no guarantee of successfully finding an alternative network. Additionally, such a manual approach also causes a  
15 communication downtime for the user, whilst the terminal is leaving the existing network and searching (perhaps unsuccessfully) for an alternative network. For the abovementioned situation of a dual-mode GSM-TETRA MS, it is likely  
20 to take up to several minutes to search for a TETRA network whilst operating in a GSM mode, with no guarantee of success. During this time, the subscriber unit is, as indicated, effectively unusable.

25 Another solution used in dual-mode wireless communication units is the concept of 'dual watch'. A dual watch approach, as described in GB-A-2287612, applicant Motorola Ltd., enables a MS to monitor,  
30 periodically, a second network, whilst still communicating on a first network. However, due to

differences in, for example, frequency bands, modulation schemes, limits on transmit power, bandwidth restrictions, etc. between dissimilar networks, it is very difficult to implement such a dual watch mechanism.

Clearly, an improved dual-watch mechanism can be implemented using two independent receivers (and potentially two independent transmitters) in a single subscriber communication unit, one receiver configured for each communication system. However, the provision of a dual receiver solution, to constantly monitor the other network, is relatively expensive.

15

A need therefore exists for an improved mechanism for selecting, and ultimately switching between, wireless communication systems wherein the abovementioned disadvantages may be alleviated.

20

### **Summary of Invention**

According to the present invention in a first aspect there is provided a mobile station operable in at least a first wireless communication system and in a second wireless communication system, the mobile station being operable to send to a System Locator a query signal requesting the System Locator to provide information relating to connectivity of the mobile station with the first system, wherein the System Locator is accessible via the second system

30

and the mobile station is operable to send said query signal during a period when it is connected by wireless to said second system.

5 The mobile station may be operable to send to the System Locator via the second system one or more signals including information relating to current location of the mobile station for use by the System Locator in providing connectivity information  
10 relating to the first system. The information relating to current location of the mobile station may be included in or in connection with the query signal.

15 The mobile station may be operable to send the query signal periodically. Alternatively, or in addition, the mobile station may be operable to send the query signal when a predetermined event occurs or has occurred. The pre-determined event may comprise one  
20 or more of:

(i) registering on said second wireless communication system,

(ii) performing a cell handover,

(iii) roaming to a new location area.

25 The mobile station according to the first aspect may be operable to send said query signal by text or data message signalling. The query signal may include an identity address of the System Locator by  
30 which the signal can be routed to reach the System Locator via the second system



The mobile station according to the first aspect may be operable to receive via the second system a signal sent from the System Locator including information relating to connectivity with the first system. The information may indicate whether the mobile station is within communication coverage range of the first system. The information may include information about at least one operational parameter of the first system. The information may include, in relation to the first system, information including one or more of: one or more radio frequencies used, a duplex frequency offset, a list of control channel frequencies, at least one timing parameter, and a geographical boundary of coverage of the first wireless communication system.

The mobile station may be operable to receive said parameter information when the System Locator determines that the mobile station is within communication coverage range of the first system.

The mobile station may be operable to send successive query signals via the second system to the system Locator and to receive in response to such query signals response signals in which the information received from the System Locator via the second system is updated for each response signal, recognising movements in location of the mobile station.

The mobile station may be operable to use the received information to determine whether to search for the first system. The mobile station may be operable following receipt of a signal from the System Locator via the second system indicating that the mobile station is within wireless communication coverage range of the first system to switch its operation to wireless communication with the first system.

According to the present invention in a second aspect there is provided a wireless communication architecture including a first wireless communication system, a second wireless communication system, a System Locator accessible by the second system and at least one mobile station operable alternatively in either the first system or the second system, wherein the mobile station is a mobile station according to the first aspect.

In the wireless communication architecture according to the second aspect, the first and second systems may be systems using different communication protocols. The first and second systems may be mobile communication network systems. One of the first and second systems may for example be a system operating according to GSM standards. The other one of the first and second systems may for example be a system operating according to TETRA standards.

Alternatively, one system may be a GSM system and

the other system may be a known IS136 or a known CDMA system.

5 The System Locator may be included within a management control function in said first wireless communication system or said second wireless communication system. It may comprise a programmable digital signal processor in any of the forms known in the art. The System Locator may be operable to store  
10 operational information relating to said first wireless communication system, and optionally relating to said second wireless communication system.

15 According to the present invention there is provided a System Locator for use in the architecture according to the second aspect. The System Locator may be operable to provide information to at least one dual-mode mobile station connected by wireless  
20 to the second wireless communication system and capable of operating in the first wireless communication system, such that said information relates to connectivity of the mobile station with the first system. The System Locator may be operable  
25 to operable to generate and provide the connectivity information using information relating to the current location of the mobile station. The information relating to the current location of the mobile station may be information sent in or in  
30 connection with a query signal by the mobile station. The System Locator may be operable to send

to the at least one mobile station via the second system information relating to at least one operational parameter of said first wireless communication system or use by the at least one  
5 mobile station in searching for and/or switching its operation to said first wireless communication system.

According to the present invention in a fourth  
10 aspect there is provided a method of selecting a wireless communication system in a wireless communication architecture that includes a first wireless communication system and a second wireless communication system, the method comprising the step  
15 of:

operating at least one dual-mode mobile station unit by wireless connection in said second wireless communication system; and

determining a location of said at least one  
20 mobile station;

the method being characterised by the step of:

providing information relating connectivity of said mobile station with said first system, the information including optionally at least one  
25 operational parameter of said first wireless communication system, said information being provided to said at least one mobile station via said second wireless communication system.

30 By providing operational information about a neighbouring communication system or network in the

manner of the invention, an MS may beneficially limit the time taken in searching for and registering on alternative networks. Preferably, the operational information is received from a  
5 System Locator in the MS's home network (e.g. a TETRA network), access via the network it is currently operating in (e.g. a GSM network).

Preferably, the dual-mode MS may query its home  
10 network about possible alternative networks in the area where the MS is currently operating. When the query includes information about the MS's geographic location, or information of the network it is currently operating on, the alternative network  
15 response can be tailored for the MS's current location.

The network currently supporting communication to/from a MS aids the MS in contacting the System  
20 Locator to determine whether or not the MS should search for and/or to attempt to switch networks. This saves the MS from the need to leave the current network in order to perform random searches for an alternative network.

25 The potential speed of such a method of finding a switching to another system, e.g. a home network, is of considerable practical benefit to the user.

30 A particular implementation of the present invention is that whilst operating on a GSM system, the MS

will be able to query its home TETRA system as to whether or not there is TETRA coverage in the area where the MS is located. The operational information is preferably communicated using short messages  
5 (e.g. a short message service (SMS) on GSM and/or a supplementary data service (SDS) on TETRA). Other methods, such as Internet Protocol (IP) using packet data transfer through the Internet, can also be used.

10

GB-A-2313257 discloses a "Bulletin Board System" (BBS) to provide identification of usable radio-systems in the area where a radio is located.

However, the arrangement described requires the  
15 existence of a separate radio-system, the "Common Communications Systems" (CCS). Through the CCS the radio receives information from the BBS. However, unlike the invention, the radio does not receive the information while being connected by wireless to a  
20 usable communication system, one which provides communication with other radios, and therefore while working actively on one of the communication systems. Thus the arrangement of GB-A-2313257 requires the radio to interface separately with a  
25 radio-system (the CCS) just for the purpose of obtaining information about the usable systems available. The information about the systems available is not updated while the radio is currently working in a particular communication  
30 system because the radio is not then connected to the CCS and there is no actual or contemplated use

of the facilities which can be provided by such a working system (e.g. use of SMS, Packet Data, IP routing of messages etc. available in GSM and TETRA systems). The radio does not look for other systems  
5 whilst continuing to work on the current working system.

Exemplary embodiments of the present invention will now be described, with reference to the accompanying  
10 drawings, in which:

### **Brief Description of the Drawings**

FIG. 1 is a block schematic diagram (also reflecting  
15 coverage area) of a wireless communication architecture adapted in accordance with an embodiment of the present invention; and

FIG. 2 is a flowchart of events and states of a  
20 mobile station and System Locator performing a method of selecting a wireless communication system, in accordance with an embodiment of the present invention.

### **25 Detailed Description of Embodiments of the Invention**

Although the following embodiment of the present invention is described with reference to interaction between a TETRA system and a GSM system, it is  
30 within the contemplation of the invention that the

inventive concepts described herein can be applied to any two or more wireless communication systems.

Referring first to FIG. 1, a schematic diagram 100 of a system architecture comprising a combination of communication systems is shown. The diagram includes a trunked radio communication system, supporting a TETRA (TERrestrial Trunked Radio) air-interface protocol, shown in outline, adapted in accordance with an embodiment of the invention. The European Telecommunications Standards Institute (ETSI) has defined the TETRA air-interface. Generally, the air-interface protocol is administered from base transceiver sites that are geographically spaced apart - one base site supporting a cell (or, for example, sectors of a cell) - providing a defined TETRA coverage area 123. A second cellular radio telephone system, for example a Global System for Mobile (GSM) communications, is shown, in the vicinity of the TETRA system with coverage area 173. The GSM air-interface has also been defined by ETSI.

In the TETRA system, a plurality of subscriber units, such as a mixture of MSs 112-116 and fixed terminals (not shown), communicate over the selected air-interface 118-120 with a plurality of base transceiver stations (BTS) 122-132. A limited number of MSs 112-116 and BTSs 122-132 are shown for clarity purposes only.



The system infrastructure in a TETRA system is generally referred to as a switching and management infrastructure (SwMI) 110, which substantially contains all of the system elements apart from the mobile units. The BTSs 122-132 may be connected to a conventional public-switched telephone network (PSTN) 134 through base station controllers (BSCs) 136-140 and mobile switching centres (MSCs) 142-144.

Each BTS 122-132 is principally designed to serve its primary cell, with each BTS 122-132 containing one or more transceivers. The BTSs 122-132 communicate 156-166 with the rest of the trunking system infrastructure via a frame relay interface 168.

Each BSC 136-140 may control one or more BTSs 122-132, with BSCs 136-140 generally interconnected through MSCs 142-144. Each BSC 136-140 is therefore able to communicate with one another, if desired, to pass system administration information therebetween, with BSCs 136-140 responsible for establishing and maintaining control channel and traffic channels to serviceable MSs 112-116 affiliated therewith. The interconnection of BSCs 136-140 therefore allows the trunked radio (or cellular phone) communication system to support handover of the MSs 112-116 between cells.

Each MSC 142-144 provides a gateway to the PSTN 134 and, although not shown, they can provide an

interface to a packet data network, e.g. Internet, through some manner of Packet Data Gateway. MSCs 142-144 are interconnected through an operations and management centre (OMC) 146 that administers general control of the trunked radio system 100, as will be understood by those skilled in the art. The various system elements, such as BSCs 136-138 and OMC 146 include control logic 148-152 with the various system elements usually having associated memory. The memory typically stores historically compiled operational data as well as in-call data, system information and control algorithms.

In a preferred embodiment of the present invention, the OMC 146 has been adapted to include a System Locator 155. The System Locator 155 provides information relating to one or more alternative systems offering service or coverage within the geographical areas that are also supported by the TETRA system. In the preferred embodiment of the present invention, the System Locator 155 within the OMC 146 contains operational information relating to the GSM system, supporting GSM communications in coverage area 173.

In accordance with the preferred embodiment of the present invention, the System Locator 155 in the TETRA system is configured to inform the MS 172 operating in the GSM system 173 whether or not there is a TETRA system in the area it is located.

Preferably, the System Locator 155 also informs the

MS 172 of the radio frequencies the TETRA network  
uses. This enables the MS 172 to search  
automatically for a TETRA network only when there is  
a good chance that there is a TETRA network in its  
5 operating area.

When the MS 172 recognises there is a TETRA network  
in the area, the MS 172 is preferably restricted to  
search only a limited range of TETRA radio  
10 frequencies. The provision of such radio frequency  
information to MS 172 greatly reduces the amount of  
time the MS 172 is out of GSM service in searching  
for a TETRA system. Furthermore, the time it takes  
to typically find a TETRA network is also reduced.

15

It is within the contemplation of the invention that  
the System Locator 155 may be supported in one or  
more of the communication systems, for example the  
GSM and/or TETRA communication system of FIG. 1.

20 Alternatively, it is envisaged that the System  
Locator may be located distal from, but operably  
coupled to, both wireless communication systems.

The System Locator 155 preferably includes a  
25 database that stores locations of known TETRA  
systems. It is envisaged that the System Locator  
155 may also store information on known GSM systems,  
which is advantageous in situations, for example,  
where the System Locator 155 was a stand-alone  
30 device and operably coupled to both the TETRA and  
GSM networks.

In addition to the RF channels used by a network, the database preferably includes information on:

- (i) Any duplex frequency offset used,
- 5 (ii) A list of Control Channel frequencies used by the TETRA networks, and/or
- (iii) The geographical boundaries of the TETRA networks if the MS provides geographic location information.

10

The OMC 146 of the TETRA system is preferably operably coupled to the OMC 176 of the GSM system, at least via the System Locator 155, so that information, such as operating radio frequencies, system timing parameters, etc. relating to both

15 systems can be passed therebetween.

In a similar manner to the TETRA system, the GSM system may include an OMC 176 that is operably

20 coupled to a BTS 174. The BTS supports GSM communication to/from MS 172. The other infrastructure elements of the GSM system, which roughly follow the same principles and architecture of the TETRA system, are not shown for clarity

25 purposes only.

In an alternative embodiment of the present invention, the GSM network broadcasts TETRA-related information to the GSM MSs operating within its

30 network, and vice versa. This solution may require cooperation of both the GSM and TETRA operators to

agree to communicate the necessary information to communication units operating in their respective cells. It is appreciated that this alternative embodiment would also likely need amendments to the  
5 GSM and/or TETRA standard, in order to facilitate the transmission of such messages.

Referring now to FIG. 2, a flowchart 200 of events and states of the MS 172 and System Locator 155 of FIG. 1, when the MS is searching for a TETRA system whilst operating on, say, a GSM system, is shown. When operating in a GSM mode, the dual-mode (GSM-TETRA) MS (for example, MS 172) periodically sends a  
10 "Neighbour System Query" short message service (SMS) message to a known ID (phone number) on the TETRA network, as shown in step 220.

The preferred embodiment of the present invention  
20 utilises the existing message structure of GSM short message service (SMS) and/or TETRA supplementary data service (SDS) for interface between the MS and the System Locator. However, it is within the contemplation of the invention that other message  
25 structure and formats could be used to enable the users and systems to benefit from the inventive concepts described herein.

For example, it is envisaged that the transfer of  
30 information may include the use of packet data transmissions to communicate with the System Locator

that contains the TETRA and/or GSM system information. Alternatively, the transfer of information may include the use of intelligent networking to trigger communication with the System  
5 Locator containing the TETRA and/or GSM system information. The System Locator may then respond via a mobile terminated SMS message.

In contrast to periodic SMS messages being sent to  
10 the System Locator 155 of the TETRA system, for example once per hour, it is envisaged that the system information requests may be event-driven as shown in step 210. It is envisaged that such events that could trigger the query, may include:

- 15           (i) Registering on a GSM system,  
          (ii) Cell handover,  
          (iii) Upon roaming to a new Location Area in the GSM network, etc.

20 In addition, it is envisaged that any combination of two or more of the above events could be employed at different times or under different circumstances, for example, only on network registration when there is no TETRA system in the area.

25

Furthermore, it is envisaged that when the home location register (HLR) of the MS's TETRA home network receives a message that the MS is  
30 registering on a new GSM network, the System Locator may transmit TETRA system information to the MS, without the need for the MS to request it.

Any query message from the MS may contain various forms of information, as shown in step 350. It is envisaged that such information may include, for  
5 example:

(i) Information relating to the current location of the MS supplied, say by a GPS indication,

(ii) A GSM Network ID, and/or

10 (iii) A GSM Location Area (LA).

The message will be routed to the TETRA network through the network's inter-system interface (ISI).

On the TETRA network, the message will be routed to  
15 a System Locator device, as in step 310. It is envisaged that step 310 may potentially include translation to a TETRA SDS message.

If the MS provided geographic location, the System  
20 Locator can accurately determine whether the MS is in the coverage area of a TETRA network. If GSM Network ID and/or LA are provided, as in step 330, the System Locator can determine the potential TETRA networks that the MS can search for.

25

The System Locator then sends a query response to the MS, using, say, a SMS GSM message (or TETRA SDS that will be translated to SMS before being routed to the GSM network), as shown in step 340. The  
30 message indicates whether or not there is a TETRA network in the area. If there is a TETRA network in

the area, the message also preferably includes information about the radio frequency (RF) channels and/or timing used by the TETRA network(s).

- 5 It is envisaged that the System Locator may also send the MS information on the Network IDs of the TETRA networks in the MS's area. In this manner, the MS could choose not to leave the GSM system, and search for a TETRA network, if it knows that none of  
10 the TETRA networks are allowed or preferred networks.

- It is further envisaged that, where the MS provides geographic location information, the System Locator  
15 may also send the MS information on whether the MS is near a TETRA network, so that the MS may search for the network periodically, even before sending the next query, if it so wishes.

- 20 When receiving the query response in step 230, the MS determines whether it is in the coverage area of a TETRA network, as in step 240, based on the information received and its location (if known). If the MS determines that it may be in such a  
25 coverage area, it will search for the one or more TETRA systems, as shown in step 250. If a TETRA system is found in step 260, the MS may leave the GSM system and register on the TETRA system, as shown in step 270.



If the location determination is based on the GSM Network identifier (mobile network identity (MNI)) and other information such as Location Area from step 350, then it is envisaged that the database may  
5 include, for each TETRA network, a list of GSM networks that are active in the coverage area of the TETRA network.

The preferred configuration of operably coupling the  
10 System Locator to the alternate network (e.g. GSM) via an OMC link is shown as an example only. It is envisaged that a further example of a connection from the System Locator to the alternate network may be through a visitor location register (VLR)/ home  
15 location register (HLR) interface.

In an alternative configuration, the System Locator may be connected to the alternate network via a short message service centre (SMSC) routing the  
20 messages directly to the System Locator, for example using an Internet protocol (IP)-based structure. A skilled artisan would appreciate that other network configurations could also benefit from the inventive concepts described herein. Additionally, the two or  
25 more wireless communication systems may be adjacent one another, overlapping, or substantially contained within one another in a pico-cell to micro-cell to macro-cell manner. As such, the wireless communication systems only need to be in the  
30 vicinity of one another to facilitate a potential hand-over of wireless communications therebetween.

The inventive concepts find particular application in use between dissimilar communication systems, for example a GSM cellular communication system and a  
5 private mobile radio communication system. It is within the contemplation of the invention that such routing of neighbouring system information may be utilised in any other wireless communication system, such as a wireless local area networks (WLANs), a  
10 third generation partnership project (3GPP) communication system, etc.

Although the aforementioned inventive concepts have been described with reference to interaction between  
15 TETRA and GSM systems, it is within the contemplation of the present invention that such concepts can be applied to other types of wireless cell-based communication systems. For example, an MS operating on a GSM system may receive information  
20 on neighbouring iDEN<sup>TM</sup> systems and vice versa; an MS operating in IS-136 system may receive information on neighbouring GSM systems and vice versa; an MS operating on a foreign TETRA system may receive information on its Home TETRA system.

25

Although the invention preferably utilises the GSM SMS and TETRA SDS mechanism to transfer messages between the MS and the System Locator, it is envisaged that other mechanisms may be used. For  
30 systems other than TETRA and GSM, it is envisaged

that their particular short message mechanism(s) may replace the GSM SMS or TETRA SDS message formats.

In addition, the interface between the two or more systems may be implemented using other methods, such

5 as IP messages, where the System Locator can be connected to the Internet. Advantageously, if an Internet interface is used, no agreement between the system operators is required.

10 Furthermore, it is envisaged that a third party may provide a stand-alone System Locator that can be operably coupled to any two or more neighbouring (or overlapping) wireless communication systems.

However, such an implementation would need to  
15 consider the security aspects associated with implementing such a standard interface to multiple wireless communication systems.

It will be understood that the wireless  
20 communication architecture and method of selecting a wireless communication system, as described above, provides at least the following advantages:

(i) An MS may limit the time taken in  
25 searching and registering on alternative networks by receiving information about alternative networks from, say, the MS's home network, via the network it is currently operating in.

(ii) By including Network IDs (MNIs) in the communication to the MS, the MS can check whether it has received authorisation to operate on the alternative networks in its current location,  
5 without first needing to start a registration process with, or connect to, the alternative network.

(iii) A mechanism is provided for a dual-  
10 mode MS to query, say, its home network about possible alternative networks in the area where the MS is currently operating. When the query includes the MS's geographic location, or information of the network it is currently operating on, the  
15 alternative network response can be tailored for the MS's current location.

(iv) The network currently supporting communication to/from a MS aids the MS in  
20 determining whether or not to attempt to switch between systems. This prevents the MS from needing to leave the current network in order to perform random searches for an alternative network.

(v) A variety of message formats may be used  
25 to inform the MS of alternative systems, for example, SMS messages to interface with the System Locator when it is located within the TETRA system or using Packet Data when it is communicating via,  
30 say, the Internet.

Thus, an improved mechanism for monitoring, and ultimately switching between, wireless cellular-based communication systems has been described wherein the disadvantages associated with prior art  
5 arrangements have been substantially alleviated.

## Claims

1. A mobile station (172) operable in at least a first wireless communication system (123) and in a second wireless communication system (173), the mobile station being operable to send to a System Locator (155) a query signal requesting the System Locator to provide information relating to connectivity of the mobile station with the first sytem, wherein the System Locator is accessible via the second system and the mobile station is operable to send said query signal during a period when it is connected by wireless to said second system.

2. A mobile station according to claim 1 and wherein the mobile station is operable to send to the System Locator via the second system one or more signals including information relating to current location of the mobile station.

3. A mobile station according to claim 2 and wherein the information relating to current location of the mobile station is included in or in connection with the query signal.

4. A mobile station according to any one of the preceding claims and wherein the mobile station is operable to send the query signal periodically.

5. A mobile staion according to any one of the preceding claims and wherein the mobile station is

operable to send the query signal when a predetermined event occurs or has occurred.

6. A mobile station according to claim 5, wherein the pre-determined event comprises one or more of:

- (i) registering on said second wireless communication system (173),
- (ii) performing a cell handover,
- (iii) roaming to a new location area.

7. A mobile station according to any one of the preceding claims and which is operable to send said query signal by text or data message signalling.

8. A mobile station according to any one of the preceding claims and wherein the mobile station is operable to produce a signal including an identity address of the System Locator and to send the signal to the System Locator via the second system.

9. A mobile station according any one of the preceding claims and wherein the mobile station is operable to receive via the second system a signal sent from the System Locator including information relating to connectivity with the first system.

10. A mobile station according to claim 9 and wherein the mobile station is operable to receive via the second system from the System Locator a signal indicating whether the mobile station is within communication coverage range of the first system.

11. A mobile station according to claim 9 or claim 10 and wherein the mobile station is operable to receive signals including information about at least one operational parameter of the first system.

12. A mobile station according to claim 11 and wherein the mobile station is operable to receive, in relation to the first system, information including one or more of: one or more radio frequencies used, a duplex frequency offset, a list of control channel frequencies, at least one timing parameter, and a geographical boundary of coverage of the first wireless communication system (123).

13. A mobile station according to claim 12 and wherein the mobile station is operable to receive said information when the System Locator determines that the mobile station is within communication coverage range of the first system.

14. A mobile station according to any one of claims 9 to 13 and wherein the mobile station is operable to send successive query signals via the second system to the system Locator and to receive in response to such query signals response signals in which the information received from the System Locator via the second system is updated for each response signal.

15. A mobile station according to any one of claims 9 to 14 and which is operable to use the received



information to determine whether to search for the first system.

16. A mobile station according to any one of claims 9 to 15 and wherein the mobile station is operable following receipt of a signal from the System Locator via the second system indicating that the mobile station is within wireless communication coverage range of the first system to switch its operation to wireless communication with the first system.

17. A wireless communication architecture (100) including a first wireless communication system (123), a second wireless communication system (173), a System Locator (155) accessible by the second system and at least one mobile station operable alternatively in either the first system or the second system, wherein the mobile station is a mobile station according to any one of claims 1 to 16.

18. A wireless communication architecture according to claim 17 wherein the first and second systems are systems using different communication protocols.

19. A wireless communication architecture according to claim 18 wherein the first and second systems are mobile communication network systems.

20. A wireless communication architecture according to any one of claims 17 to 19 and wherein one of the

first and second systems is a system operating according to GSM standards.

21. A wireless communication architecture according to any one of claims 17 to 20 and wherein one of the first and second systems is a system operating according to TETRA standards.

22. A wireless communication architecture (100) according to any one of claims 17 to 21 and wherein the System Locator is included within a management control function in said first wireless communication system (123) or said second wireless communication system (173).

23. A wireless communication architecture (100) according to any one of claims 16 to 22, wherein the System Locator (155) is operable to store operational information relating to said first wireless communication system (123), and optionally relating to said second wireless communication system (123).

24. A System Locator (155), operably coupled to a first wireless communication system (123) and a second wireless communication system (173), wherein the System Locator (155) is operable to provide information to at least one dual-mode mobile station (172) connected by wireless to the second wireless communication system and capable of operating in the first wireless communication system, such that said information relates to connectivity of the mobile station with the first system.

25. A System Locator according to claim 24 and which is operable to provide the connectivity information using information relating to the current location of the mobile station.

26. A System Locator according to claim 25 and wherein the information relating to the current location of the mobile station is information sent in or in connection with a query signal by the mobile station.

27. A System Locator according to any one of claims 24 to 26 and wherein the System Locator is operable to send to the mobile station via the second system information relating to at least one operational parameter (330) of said first wireless communication system (123) for use by the at least one mobile station (172) in searching for and/or switching its operation to said first wireless communication system (123).

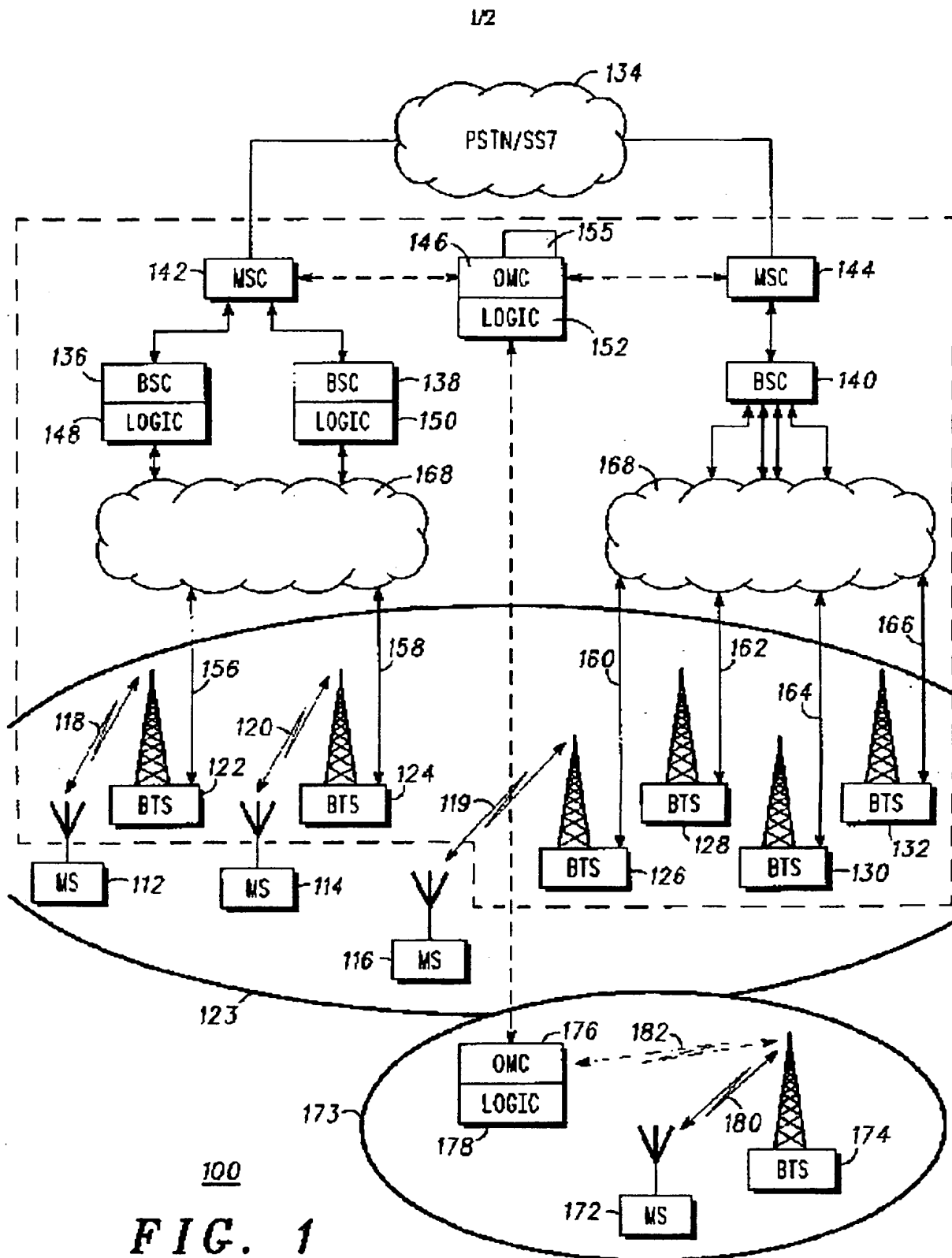
28. A method of selecting a wireless communication system in a wireless communication architecture (100) that includes a first wireless communication system (123) supporting communications in the vicinity of a second wireless communication system (173), the method comprising the step of:

operating at least one dual-mode mobile station unit (172) by wireless connection in said second wireless communication system (173); and

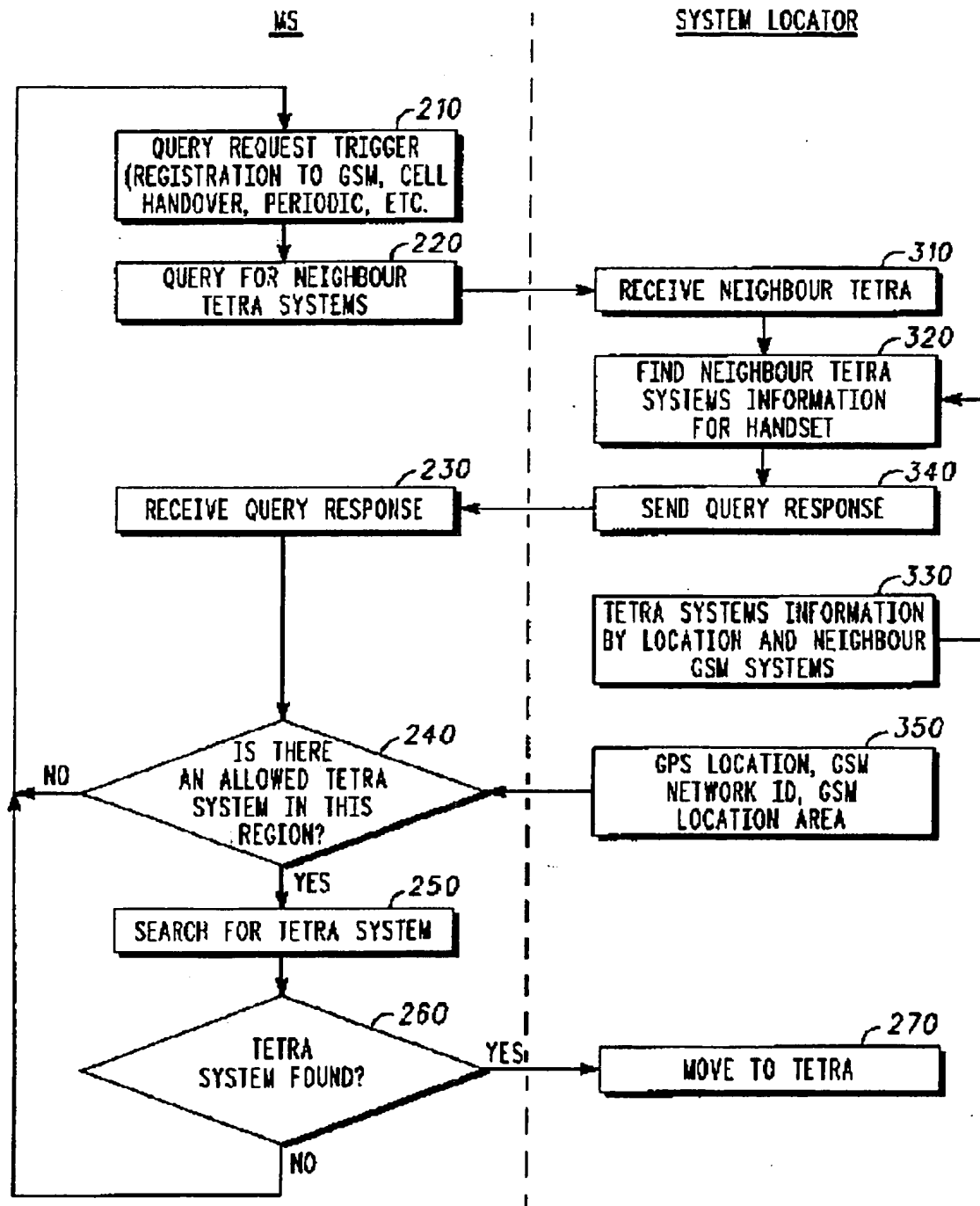
determining a location of said at least one mobile station(172);

the method being characterised by the step of:

providing (340) information relating connectivity of said mobile station with said first system, the information including optionally at least one operational parameter (330) of said first wireless communication system (123), said information being provided to said at least one mobile station via said second wireless communication system (173).



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**FIG. 2**

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/50110

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04Q7/20 H04M3/42

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	US 5 822 418 A (YACENDA MICHAEL W ET AL) 13 October 1998 (1998-10-13) column 1, line 20 -column 2, line 48 abstract	1-28
Y	US 5 924 040 A (TROMPOWER MICHAEL L) 13 July 1999 (1999-07-13) column 2, line 65 -column 4, line 35 abstract; figures 6,7	1-28
Y	US 6 006 096 A (TROMPOWER MICHAEL L) 21 December 1999 (1999-12-21) column 1, line 19 -column 5, line 64 abstract; figures 8-10	1-28
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

## \* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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- "&" document member of the same patent family

Date of the actual completion of the international search

14 July 2003

Date of mailing of the international search report

25. 07. 2003

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 03/50110

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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